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What drives the gender wage gap in the New Zealand public specialist workforce?

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Title: **What drives the gender wage gap in the New Zealand public specialist workforce?**

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ABSTRACT

Objectives: To estimate the gender gap in hourly wages earned by medical specialists in their main jobs after controlling for age, number of hours worked, and medical specialty.

Design: Observational using governmental administrative and survey data.

Setting: New Zealand public employed medical workforce

Participants: 3510 medical specialists who were employed for wages or a salary in a medical capacity by a New Zealand DHB at the time of the March 2013 Census, whose Census responses on hours worked were complete and can be matched to tax records of earnings to construct hourly earnings.

Main outcome measures: Hourly earnings in the DHB job calculated from usual weekly hours worked reported in the Census and wage or salary earnings paid in the month recorded in administrative tax data.

Results: In their DHB employment, female specialists earned on average 12.5 percent lower hourly wages than their male counterparts of the same age, in the same specialty, who work the same number of hours (95 percent CI 9.9 to 15.1 percent). Adding controls for a wide range of personal and work characteristics decreased the estimated gap only slightly to 11.2 percent (95 percent CI 8.6 to 13.8 percent). At most, 4.6 percentage points can be explained by gender differences in experience at the same age.

Conclusions: Male specialists earn a large and statistically significant premium over their female colleagues. Age, specialty and hours of work do not appear to drive these wage gaps. These findings suggest that employment agreements that specify minimum wages for each level of experience, and progression through these levels, are insufficient to eliminate gender wage gaps between similar men and women with the same experience.

STRENGTHS AND LIMITATIONS OF THE STUDY

- To the best of the authors knowledge, this is the first study to examine the extent and drivers of gender wage gaps among senior doctors, using actual earnings data in a nationwide study. Further, it appears to be the first to examine doctor remuneration in relation to collective employment agreements or public health sector employment alone.
- Earnings data are from tax records, so are not subject to self-reporting bias.
- The sources of the data on hours worked and monthly earnings are different, so some error is introduced through mismatched individuals and individuals whose pay in March 2013 was the result of a different numbers of hours of work to their usual hours, and some specialists with three or more jobs are lost because the hours worked in their DHB job can't be identified.
- The data are cross-sectional from 2013, not longitudinal, so the wage growth of individual specialists over time cannot be analysed.

INTRODUCTION

Despite their growing presence in medical workforces, women continue to earn significantly less than their male doctor counterparts[1,2]. International research suggests wage gaps between male and female doctors ranging from 13% in the US[3] to 17-23% in Australia[4] and 34% in the UK[5]. The prevalence of gender pay gaps in medicine has been ascribed to the tendency for female doctors to self-select into lower paid medical specialities[6], to work fewer hours than their male counterparts[7] and to take time out of the paid workforce for maternity leave[8]. Other research suggests a pay gap as a consequence of the 'breadwinner effect', where men with children earn more than those without, and the 'carer effect', where women with children earn less than those without[9,10]. In addition, research suggests women in medicine face subtle gender based discrimination[11], are less likely to negotiate on salary offers, all of which may contribute to the persistence of a wage gap[12] .

Little is currently known as to the extent and drivers of gender wage gaps among senior doctors specifically, referred to hereafter as medical specialists. Furthermore, to the best of the authors knowledge, there are no studies examining doctor remuneration in relation to collective employment agreements or public health sector employment. This research quantifies the gender wage gap for medical specialists in New Zealand public health system employment using actual earnings data, with a focus on controlling for factors such as hours worked and medical speciality, which are commonly ascribed factors for gender wage gaps.

According to the OECD, New Zealand's 2018 gender wage gap in median earnings for all full-time employees was 7.9 percent, considerably below the 13.5 percent on average for OECD countries[13]. Statistics New Zealand (using different methodology) calculated a slightly higher gender wage gap of 9.2 percent in the same year[14]. Neither estimates control for any individual characteristics such as occupation, age, or level of education. Other recent New Zealand studies that estimate the wage gap between similar men and women find it remains sizeable even when controlling for characteristics of the individuals and their jobs[15-17]. Significantly, these studies find a larger wage gap between men and women who are more skilled or higher up the earnings distribution.

New Zealand has a large public health system that provides free or subsidised health and disability services to the New Zealand population, mainly funded through general taxation. The majority of funds managed by the Ministry of Health are allocated to 20 District Health Boards (DHBs). Publicly employed medical staff are employees of and paid by the DHBs. Instead of or in addition to DHB employment, medical specialists may work in the private health system, which operates alongside the public health system and caters to those with private insurance, among others. The majority of general practitioners operate in a private practice capacity.

The medical profession is not typical of high-skill professions in New Zealand. In particular, unionisation among medical specialists working in the public health system is very high, and the pay and conditions negotiated by their union, the Association of Salaried Medical Specialists (ASMS), in their Multi Employer Collective Agreement (MECA) with the 20 DHBs are extended to publicly employed specialists who are not union members, subject to a few conditions. Among other conditions of employment, the MECA specifies minimum salary levels for medical specialists at each level of experience and progression through them. Specialists are assigned to a step when they take up employment with a DHB. This could be the first step if they are newly qualified, or could be negotiated between the employee and employer based on past experience and qualification level. In the experience of ASMS, overwhelmingly members advance a step each year until they reach the top step. Those on approved unpaid leave for up to a period of six months, or on parental leave for up to twelve months, are still eligible for these regular pay increases.

In addition to base pay, the MECA specifies that a DHB may pay additional “recruitment and retention benefits” to address actual or potential recruitment problems, and “special contributions benefits” to recognise special skills or responsibilities[18]. Furthermore, it should be noted the MECA sets out minimum pay and conditions for specialists, and individuals or groups may negotiate more favourable additional conditions with their employer. Nonetheless, the salary minima for each step and regular progression through the steps are expected to reduce the scope for a wage gap to arise between equally skilled and experienced men and women who are employed as medical specialists by DHBs.

In this context, we explain our approach to data and analysis before comparing raw characteristics and outcomes of men and women.

METHODS

The main data source used in this research was the Integrated Data Infrastructure (IDI) managed by Statistics New Zealand. The IDI brings together administrative data for the full population of New Zealand and selected survey data from a wide range of sources, and links records for individuals between different data sources. Specifically, this research used the 2013 Census of Population and Dwellings, which provides data on occupation (specialty) and weekly hours worked along with a multitude of other personal and employer characteristics, and the employer monthly schedule (EMS) from Inland Revenue, which records wages paid each month by each employer to each employee in the country.[1] This combination of data sources provided the most recent and complete data available at the time of writing on earnings and hours worked for the full population of DHB-employed medical specialists. In addition, we use the Ministry of Education's tertiary qualifications data to construct the dates individuals received their medical degrees.

Participants

The conceptual population of interest was medical specialists who were employed for wages or a salary in a medical capacity by a DHB at the time of the March 2013 Census. This included individuals for whom this DHB job was the only or main job, and those for whom it was a secondary job. The sample from this population was all individuals who stated their occupation in the Census as a medical specialty (see Appendix A: Included specialties), and who were shown in the EMS to have received wages from a DHB in March 2013, the month of the Census. However, individuals who met these criteria but were observed in the Ministry of Education data to receive a Bachelor of Medicine and Bachelor of Surgery (medical degree) from a New Zealand institution after the year 2013 were excluded. This yielded an overall sample of 4,041 specialists.[2]

Whether or not individuals were International Medical Graduates (IMGs) was determined by analysis of Ministry of Education Qualifications data and Census data on country of birth and years in New Zealand. Individuals were classed as IMGs if they did not receive a medical degree in New Zealand (since 1994, the year data on degrees granted began), were born overseas, and migrated to New Zealand when aged 24 or older. The rationale for this cut-off was that 24 years old is both the modal and median age for receiving a medical degree in New Zealand since 1994.

Patient and Public Involvement

No patients involved

Measures

The primary wage outcome of interest was individual hourly wage earnings in the individual's largest DHB job. This variable was calculated as monthly wages paid by the highest-paying DHB employer divided by weekly hours worked in the DHB job reported in the Census, times (7/31). This calculation was complicated by the necessity of matching Census jobs (the source of hours worked) with EMS jobs (the source of earnings) and the way hours worked is asked in the Census. The Census collects most information about the "main job", defined as the job in which the individual worked the greatest number of hours. Statistics New Zealand processes the information and provides data on industry and sector of employer for main job. Industry and sector are also available for the employer in the EMS data. We applied several criteria sequentially to determine which EMS job (if any) was the main Census job. First, we considered an EMS job to be the main job if it fully matched the main Census job in terms of sector and detailed industry. If two or more EMS jobs met this criterion, the one paying the highest wages was considered the main job. Second, if the sector matched and the industry matched at only the 2-digit level (aggregate industry classification) we defined the EMS job as the main Census job. Multiple matches were dealt with by choosing the EMS job with higher wages. If no EMS jobs matched the sector and aggregate industry of the main Census job, no EMS job was allocated as the main Census job. Inability to identify the main job in the EMS data caused the loss of some observations from our hourly wage data set.

The Census collects two hours worked variables: hours worked in main job and hours worked in all other jobs.[3] If the DHB job is the individual's main job or only job other than their main job, the answers to these questions allowed us to identify how many hours they work for the DHB. We lost from the hourly wage data set observations for individuals with three or more jobs for whom the DHB job was not their main job. We also lost observations where the individual did not complete the Census questions on hours worked, and we dropped the small number of cases for which our calculation yielded wages below $15 an hour.[4] This process resulted in 3,510 observations of hourly wages in main DHB job, which amounted to 86.9% of the desired population.

RESULTS

Table 1 presents descriptive statistics for the work outcomes and main controls used in the regression analysis.

Table 1: Means and standard deviations of outcomes of interest and control variables for the sample of specialists with non-missing DHB hourly wage earnings.

	Mean	Standard deviation
Monthly wage earnings in DHB job	$14,408	$7,188
Weekly hours worked in DHB job	43.7	14.2
Hourly wage in DHB job	$82	$58
Female	0.370	
Age	44.3	11.7
Number of children in family	1.08	1.22
Foreign born	0.561	
Overseas trained (IMG)	0.411	
Any non-European ethnicity	0.255	
Asian ethnicity	0.182	
Currently partnered	0.826	
Previously partnered	0.039	
Never partnered	0.135	
Bachelor's degree	0.365	
Honours or Master’s degree	0.357	
Doctorate	0.276	

Figure 1 displays the change in mean hourly wage in the DHB job and its 95% confidence interval, unadjusted for any characteristics, by age for each gender for medical specialists. For both genders, hourly wages increase gradually to the age of about 30, increase rapidly over the next 10 or 15 years, and then flatten out. This is roughly the age at which specialists who gain their medical degrees at age 24 might be expected to reach the top salary step specified in the MECA that was in force in March 2013. The gender pay gap in average hourly earnings is small and fairly constant until age 40, but beyond that increases rapidly to give men a wage advantage over women.

Figure 1: Raw hourly wage in main DHB job by age and gender

Gender difference in hourly wage

The gender wage gap in hourly wage earned in specialists’ main DHB jobs was calculated by running an ordinary least squares regression at the individual level of the log of hourly earnings on a dummy variable for female and progressively adding in other controls. Column (1) of Table 2 presents the results of the most basic regression, which includes no additional controls. The coefficient of -0.237 on female, which is highly statistically significant, shows that in her DHB job the average female specialist earned an hourly wage that is 21.1 percent lower than the hourly wage of the average male specialist.[5] Column (2) flexibly controls for age using an age spline of order 4, which closely fits the shape of the age-earnings relationship shown in Figure 1, and compares the earnings of men and women of the same age. Here the coefficient on age falls to -0.106, indicating women earn hourly wages 10.1 percent lower than men of the same age. The existence of a gender wage gap between medical specialists of the same age suggests the lower hourly wages of female specialists relative to male specialists is not the result of the female specialists being younger on average.

Table 2: Main estimates of gender wage gap

Dependent variable: Hourly wages in main DHB job (ln)	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.237***	-0.106***	-0.097***	-0.134***	-0.137***	-0.119***
	(0.019)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Hours worked in main DHB job (omitted 41-50 hours)						
30 or fewer hours				0.230***	0.232***	0.196***
				(0.024)	(0.024)	(0.027)
31-40 hours				0.044***	0.045***	0.043**
				(0.017)	(0.017)	(0.017)
51-60 hours				-0.149***	-0.151***	-0.142***
				(0.015)	(0.015)	(0.016)
Over 60 hours				-0.288***	-0.291***	-0.280***
				(0.022)	(0.022)	(0.022)
One-child family						0.017
						(0.021)
Two or more-child family						0.009
						(0.019)
Highest qualification (omitted bachelor's degree)						
Honours and Master's						0.025
						(0.016)
Doctorate						0.084***
						(0.017)
Foreign born						-0.007
						(0.020)
Overseas trained						0.037*
						(0.020)
Reports any non-European ethnicity						-0.028
						(0.023)
Reports Asian ethnicity						-0.002
						(0.027)
Social marital status (omitted non-partnered, never married or in civil union)						
Partnered						0.010
						(0.021)
Previously partnered						-0.069
						(0.046)
Self-employed						-0.007
						(0.020)
Hours worked in other jobs (omitted 0 hours)						
1-10 hours						0.095***
						(0.022)
11-25 hours						0.037
						(0.028)
26-40 hours						0.134***
						(0.049)
Over 40 hours						0.227***
						(0.068)
Flexible age controls	No	Yes	Yes	Yes	Yes	Yes
Specialty fixed effects	No	No	Yes	Yes	Yes	Yes

DHB fixed effects	No	No	No	No	Yes	Yes
Missing ctl dummies	No	No	No	No	No	Yes
R-Squared	*0.045*	*0.458*	*0.480*	*0.535*	*0.540*	*0.553*
Observations	*3,510*	*3,510*	*3,510*	*3,510*	*3,510*	*3,510*

Notes: Each column presents results from an OLS regression with dependent variable log hourly wage in main DHB job. Flexible age controls are an age spline of order 4. Missing control dummies are for hours worked in other jobs, marital status, ethnicity, country of birth, and highest qualification. All observation counts have been randomly rounded to base 3. Robust standard errors are in parentheses. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

Column (3) of the table adds fixed effects for specialty to test the extent to which the gender wage gap is driven by women selecting into lower-paying specialties. Here the coefficient on female falls slightly to -0.097, indicating than women earn an average of 9.2 percent less each hour than men of the same age in the same specialty. Comparison with column (2) shows that women have only a weak tendency to select into lower-paying specialties, and suggests this mechanism plays a very minor role in the overall gender wage gap.

Another potential explanation for the gender wage gap is that female specialists are more likely to work part time, and part-time employees might earn lower hourly wages than full-time employees. Column (4) of Table 2 adds controls for weekly hours worked in the DHB job (30 or fewer hours, 31 to 40 hours, 51 to 60 hours, and over 60 hours, with 41 to 50 hours as the omitted category). It thus compares men and women of the same age, in the same specialty, who work the same number of hours each week in their DHB job. The coefficients on the hours worked variables reveal that, on average over men and women, hourly wage is substantially higher among those who work fewer hours each week in their DHB job. Furthermore, controlling for hours worked substantially increases the coefficient on female from -0.097 to -0.134, indicating women's hourly wages lag those of men of the same age, in the same specialty, who work the same hours in their DHB job by 12.5 percent. This estimate is statistically significant at the 1 percent level and has a 95 percent confidence interval ranging from 9.9 percent to 15.1 percent.

To account for the possibility that some DHBs pay higher wages than others and women are more likely to work for low-wage DHBs, column (5) of Table 2 adds DHB fixed effects and compares similar men and women who work for the same DHB. The gender wage gap here is 12.8 percent, virtually unchanged.

Finally, column (6) of the table adds controls for a range of additional personal characteristics to test the extent to which the gender wage gap can be explained by observable characteristics that might justify differential wages. Controls are included for number of children, highest qualification, being foreign born, having trained overseas, ethnicity, social marital status, and number of hours worked in non-DHB jobs each week. In this specification, the gender wage gap falls to 11.2 percent and remains highly significant. Working in additional non-DHB jobs was strongly associated with higher hourly earnings in the DHB job. For instance, those who work 1 to 10 hours each week in other jobs earn 10.0 percent higher wages than those who work only for the DHB, and those who work 26 to 40 hours in other jobs earn 14.3 percent higher wages. Having a doctorate is also associated with significantly higher earnings.

The above analysis controls for age as a proxy for experience. However, women may have less experience than men at the same age if they entered the profession later or had more gaps in their employment, such as for raising children. For specialists who received their medical degrees in New Zealand in 1994 or later, we explored this possibility in Table 3. The baseline wage gap for this sample between men and women of the same age, controlling for other major covariates, was 6.9 percent (column 1). Instead comparing those who received medical degrees in the same year reduced the wage gap to 6.1 percent (column 2). Additionally accounting for estimated time away from work for parental responsibilities reduces the gender wage gap to 5.5 percent (column 3).[6] Thus for specialists who were qualified in New Zealand in 1994 or later, accounting for differences in age entering the profession and average breaks for parental responsibilities explains only 20.2 percent of the gender wage gap.

Table 3: Gender wage gap varying controls for experience

Dependent variable: Hourly wages in main DHB job (ln)

	Trained in NZ since 1994			
	(1)	(2)	(3)	(4)
Female	-0.072***	-0.063**	-0.057**	-0.045**
	(0.026)	(0.025)	(0.025)	(0.023)
Hours worked in main DHB job (omitted 41-50 hours)				
30 or fewer hours	0.377***	0.338***	0.345***	0.323***
	(0.086)	(0.092)	(0.090)	(0.084)
31-40 hours	0.164***	0.143***	0.141***	0.145***
	(0.044)	(0.039)	(0.039)	(0.039)
51-60 hours	-0.205***	-0.166***	-0.166***	-0.160***
	(0.025)	(0.023)	(0.023)	(0.023)
Over 60 hours	-0.320***	-0.267***	-0.267***	-0.265***
	(0.027)	(0.025)	(0.025)	(0.024)
Highest qualification (omitted bachelor's degree/level 7)				
Honours and Master's	0.014	0.009	0.011	0.003
	(0.025)	(0.024)	(0.024)	(0.025)
Doctorate	0.140***	0.076*	0.066	0.073*
	(0.045)	(0.043)	(0.043)	(0.044)
Age spline	Yes	No	No	No
Years since qual spline	No	Yes	No	No
Yrs since qual with child adjustment spline	No	No	Yes	Yes
Hours worked in other jobs controls	No	No	No	Yes
Specialty fixed effects	Yes	Yes	Yes	Yes
Highest qualification missing dummy	Yes	Yes	Yes	Yes
R-Squared	*0.622*	*0.656*	*0.659*	*0.669*
Observations	*765*	*765*	*765*	*765*

Notes: Each column presents results from an OLS regression with dependent variable log hourly wage in main DHB job. The sample is specialists who gained their medical degree in New Zealand in 1994 or more recently. All observation counts have been randomly rounded to base 3. Robust standard errors are in parentheses. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

Another way that experience might affect earnings is through longer working weeks, which enable a specialist to accumulate experience more quickly. In column (4) of Table 3 we add controls for number of weekly hours worked in other jobs, reducing the gender wage gap to 4.4 percent (significant at the 5 percent level). Overall, 36.7 percent of the gender wage gap for this subpopulation, or 2.5 percentage points of a total of 6.9, can be explained by these past and contemporaneous experience controls. Assuming differential experience at the same age had the same explanatory power in the full sample, this would mean it explained 4.6 percentage points of the overall 12.5 percent gender wage gap.

Heterogeneity in the gender wage gap

In Table 4 we present the results of regressions that test how the within-specialty gender wage gap between similar men and women differs with personal characteristics. Column (1) shows the gap increases with age, from 3.9 percent for ages 30 to 39 up to 14.2 percent for ages 40 and over. Column (2) shows the gap is larger among specialists who work fewer hours each week in their DHB job, at 20.5 percent among those who work up to 30 hours per week, compared with only 5.0 percent for those who work over 60 hours. Column (3) suggests the gap might be smaller among specialists who work more hours in other jobs, but statistical power is too low to be confident of this relationship. Column (4) shows the gap rises with number of children in the household, from 7.8 percent between men and women with no children in their families to 15.5 percent between those in families with two or more children. Column (5) shows there is no significant difference in the gender wage gap for specialists who trained overseas or recent migrants (who arrived in New Zealand no more than a year before the 2013 Census). Column (6) shows the gap is lower among more qualified specialists, falling from 15.3 percent for those with bachelor's degrees only to 6.4 percent for those with doctorates.

Table 4: Heterogeneity of gender wage gap

Dependent variable: Hourly wages in main DHB job (ln)	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.115***	-0.071***	-0.124***	-0.082***	-0.116***	-0.166***
	(0.030)	(0.021)	(0.016)	(0.019)	(0.018)	(0.024)
Aged under 30 * Female	0.075**					
	(0.037)					
Aged 40+ * Female	-0.041					
	(0.035)					
Worked 30 or fewer hours in main DHB job * Female		-0.159***				
		(0.047)				
Worked 31-40 hours * Female		-0.058*				
		(0.035)				
Worked 51-60 hours * Female		-0.037				
		(0.032)				
Worked over 60 hours * Female		0.020				
		(0.044)				
Works 1-25 hours in other jobs * Female			-0.008			
			(0.033)			
Works 26 or more hours in other jobs * Female			0.111			
			(0.107)			
Hours worked in other jobs missing * Female			0.030			
			(0.181)			
One-child family * Female				-0.053		
				(0.040)		
Two or more-child family * Female				-0.087***		
				(0.031)		

Overseas trained * Female					-0.004	
					(0.028)	
Recent migrant * Female					0.006	
					(0.059)	
Honours or Master's * Female						0.065**
						(0.032)
Doctorate degrees * Female						0.100***
						(0.034)
Highest qualification missing * Female						-1.090***
						(0.300)
One-child family				0.039		
				(0.024)		
Two or more-child family				0.046**		
				(0.019)		
Overseas trained					0.022	
					(0.016)	
Recent migrant (arrived Mar 2012 or later)					0.073*	
					(0.040)	
Flexible age controls	No	Yes	Yes	Yes	Yes	Yes
Age category fixed effects	Yes	No	No	No	No	No
Specialty fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	*0.532*	*0.548*	*0.546*	*0.547*	*0.547*	*0.548*
Observations	*3,510*	*3,510*	*3,510*	*3,510*	*3,510*	*3,510*

Notes: Each column presents results from an OLS regression with dependent variable log hourly wage in main DHB job. Flexible age controls are an age spline of order 4. Additional controls are fixed effects for number of hours worked in DHB job, fixed effects for number of hours worked in other jobs, and fixed effects for highest qualification. All observation counts have been randomly rounded to base 3. Robust standard errors are in parentheses. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

DISCUSSION

This study reports on the first analysis into the gender gap in hourly wages of a senior medical workforce across an entire country, based on actual earnings data. It extends existing research by examining associations between hourly wages and age, experience, medical speciality, and other demographic factors such as numbers of children and ethnicity. It proposes an approach to measuring and estimating gender pay gaps and further, contributes to the wider literature by considering the role of multi employer collective agreements as a factor that should limit the opportunity for gender pay gaps to arise.

Despite specialist salaries being specified by the MECA negotiated by the Association of Salaried Medical Specialists, we find male specialists earn a large and statistically significant premium over their female colleagues. When we compare male and female specialists of the same age, in the same specialty, who work the same number of hours each week, we find female specialists earn on average 12.5 percent lower hourly wages than their male counterparts in their DHB employment, with a 95 percent confidence interval of 9.9 to 15.1 percent. Adding controls for a wide range of personal and work characteristics decreases the estimated gap only slightly to 11.2 percent.

The wage gap increases with age from 3.9 percent for under-30s to 14.2 percent for those aged 40 and over. For specialists without children, there is a smaller but still statistically significant gender wage gap of 7.8 percent. This gender wage gap rises to 12.6 percent for those with one child and to 15.5 percent for those with two or more children. Given the average female medical specialist reduces her lifetime months worked by on average five months for each child she bears, and the ASMS MECA specifies that specialists on parental leave for up to 12 months will receive the same regular pay increases as they would receive were they not on leave, these wage gaps for parents cannot be explained by time out of the paid workforce for parental leave alone. As well as being larger among parents, we find the wage gap increases with age and is higher for specialists who work fewer hours each week in their DHB job, reaching 20.5 percent for those who work 30 or fewer hours, and is lower for specialists with higher degrees, falling to 6.4 percent among those with doctorates.

These wage gaps flexibly account for age, so are not driven by female specialists being younger on average than male specialists. They compare men and women in the same specialty, so are not driven by female specialists choosing to work in lower-paying specialties. They also control for weekly hours worked in the DHB job, weekly hours worked in other jobs, and highest qualification. They are thus not driven by female specialists being more likely to work part-time, either for the DHB or in total, and part-time employees earning lower hourly wages than full-time employees. In fact, although female specialists are more likely to work part-time in their DHB job, part-time specialists, especially men, tend to earn an hourly wage premium over full-time specialists.

Our results suggest that, at most, 37 percent of the 12.5 percent wage gap, or 4.6 percentage points, can be explained by differences in experience. Furthermore, the data show that hourly earnings are relatively stable for men and women beyond approximately 45 years of age, which suggests that beyond a certain level of seniority hourly wages are determined almost entirely by factors other than experience.

In the context of the MECA that governs the earnings of DHB-employed medical specialists, the gender wage gap we estimate could arise from one of two places. First, men with the same experience could be placed in higher steps on the salary scale on recruitment. This has greater potential to occur for specialists who work in New Zealand after gaining experience overseas than for New Zealand-trained specialists who have worked only in New Zealand, who are more likely to enter the pay scale on the lowest rung and deterministically progress up a step each year. Second, men could receive larger payments over and above the MECA minimum, which could include recruitment and retention benefits or special contributions benefits.

Although we do not find direct evidence that male specialists who migrate to New Zealand are initially placed on a higher pay step than similar female specialists, we do find a substantial gender pay gap among new immigrants, and are unable to rule out that such unequal treatment occurs. Our data do not allow us to distinguish base salary as specified by the MECA from the various additional payments, but our results are consistent with male specialists disproportionately receiving additional payments beyond the MECA minimum for their salary step. This demonstrates that an employment agreement that specifies minimum wages for each level of experience and progression through these levels is insufficient to eliminate the gender wage gap between similar men and women with the same experience.

The broader literature on gender pay equality proposes employer discrimination and more successful salary negotiation on the part of men as two potential explanations for a gender wage gap such as that observed here. It is possible that both play a role in the gender wage gap for medical specialists but the approach taken in this research is unable to interrogate these reasons.

Nevertheless, this research provides clear evidence that there are likely to be significant issues with gender pay inequity for medical specialists working in New Zealand's public health system. The results of this research indicate a need for a comprehensive series of gender pay audits within the nation's DHBs and to ensure that existing and future remuneration arrangements are fair and unbiased.

a. Contributorship statement: The research was designed and conducted by Dr Sin and Ms Bruce-Brand, with contributions received from Dr Chambers. All authors edited and revised the final submission and signed off on the final version.

b. Competing interests: There are no competing interests

c. Funding: This research was funded by the Association of Salaried Medical Specialists

d. Data sharing statement: No additional data available

e. Acknowledgements: Access to the anonymized data used in this study was provided by Statistics New Zealand in accordance with security and confidentiality provisions of the Statistics Act 1975, and secrecy provisions of the Tax Administration Act 1994. The findings are not Official Statistics. The results in this paper are the work of the authors, not Statistics NZ, Motu Economic and Public Policy Research, or the Association of Salaried Medical Specialists, and have been confidentialised to protect individuals, households, businesses, and other organizations from identification. See the Motu Working Paper version of this research (http://motu-www.motu.org.nz/wpapers/19_21.pdf) for the full disclaimer.

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[1] The most recent 2018 census data were deemed unsuitable due to a high non-response rate and resulting poor data quality caused by the shift to an online survey.

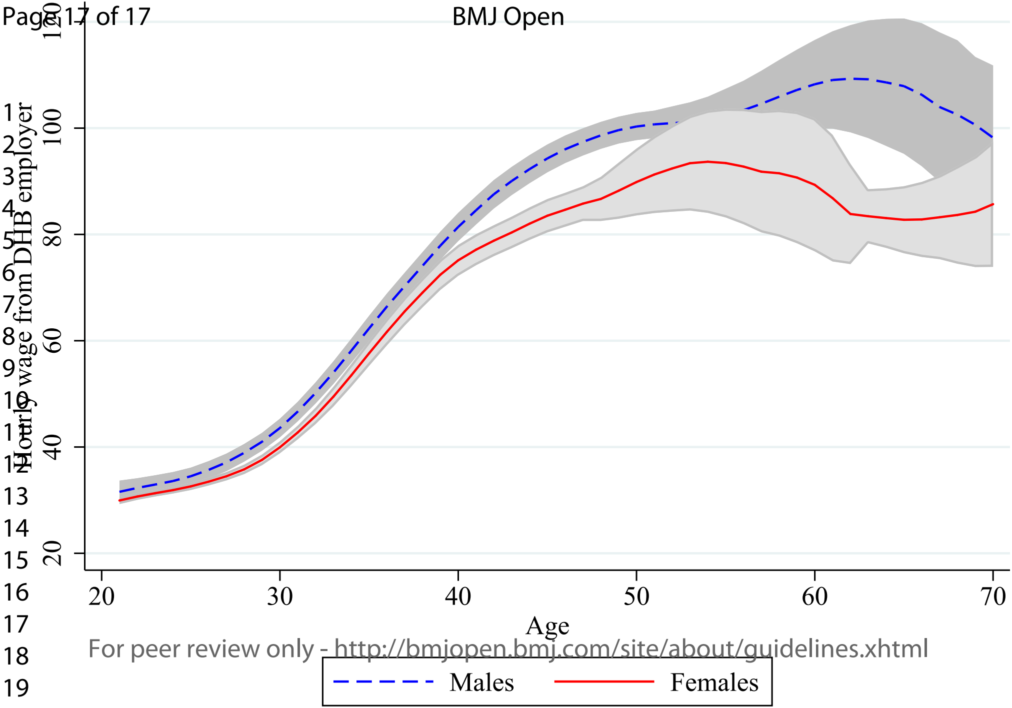
[2] These numbers, and all other population counts in this paper, have been randomly rounded to base three for confidentiality reasons, as required by Statistics New Zealand.

[3] In both cases, the wording of the question is "How many hours, to the nearest hour, do you usually work each week?" We can only speculate on how individual specialists interpret this question, but it seems plausible that many will include on call hours in the number they report.

[4] Our preferred estimate of the overall gender wage gap for specialists falls from 12.5 percent to 11.6 percent when we instead use a cut-off of $20. However, using this larger cutoff disproportionately drops (low-paid) women from the sample, so is likely to underestimate the gender wage gap.

[5] $1 - \exp(-0.237) = 21.1$ percent.

[6] Separate regressions (not shown) estimated that having a child reduces the months in which a female doctor works by 5 months on average, whereas male doctors do not decrease their months worked when they have children. An adjusted years of experience variable was constructed that was equal to years since gaining medical degree for men, and years since gaining medical degree minus five months for every live child given birth to for women. Column 3 controls flexibly for this adjusted experience measure.


Hourly wage from DHB employer
20
40
60
80
100
120
20
30
40
50
60
70
Age
Males
Females

Appendix A: Included specialties

This table lists the level 5 ANZSCO occupation codes and occupation descriptions of the medical specialties included in the analysis.

Code	Description
252311	Dental Specialist
252312	Dentist
253111	General Practitioner
253211	Anaesthetist
253311	Specialist Physician (General Medicine)
253312	Cardiologist
253313	Clinical Haematologist
253314	Medical Oncologist
253315	Endocrinologist
253316	Gastroenterologist
253317	Intensive Care Specialist
253318	Neurologist
253321	Paediatrician
253322	Renal Medicine Specialist
253323	Rheumatologist
253324	Thoracic Medicine Specialist
253399	Specialist Physicians not elsewhere classified
253411	Psychiatrist
253511	Surgeon (General)
253512	Cardiothoracic Surgeon
253513	Neurosurgeon
253514	Orthopaedic Surgeon
253515	Otorhinolaryngologist
253516	Paediatric Surgeon
253517	Plastic and Reconstructive Surgeon
253518	Urologist
253521	Vascular Surgeon
253911	Dermatologist
253912	Emergency Medicine Specialist
253913	Obstetrician and Gynaecologist
253914	Ophthalmologist
253915	Pathologist
253917	Diagnostic and Interventional Radiologist
253918	Radiation Oncologist
253999	Medical Practitioners not elsewhere classified

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Title: **The gender wage gap among medical specialists: A quantitative analysis of the hourly pay of publicly employed senior doctors in New Zealand**

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ABSTRACT

Objectives: To estimate the gender gap in hourly wages earned by medical specialists in their main jobs after controlling for age, number of hours worked, and medical specialty.

Design: Observational using governmental administrative and survey data.

Setting: New Zealand public employed medical workforce

Participants: 3510 medical specialists who were employed for wages or a salary in a medical capacity by a New Zealand DHB at the time of the March 2013 Census, whose Census responses on hours worked were complete and can be matched to tax records of earnings to construct hourly earnings.

Main outcome measures: Hourly earnings in the DHB job calculated from usual weekly hours worked reported in the Census and wage or salary earnings paid in the month recorded in administrative tax data.

Results: In their DHB employment, female specialists earned on average 12.5 percent lower hourly wages than their male counterparts of the same age, in the same specialty, who work the same number of hours (95 percent CI 9.9 to 15.1 percent). Adding controls for a wide range of personal and work characteristics decreased the estimated gap only slightly to 11.2 percent (95 percent CI 8.6 to 13.8 percent). At most, 4.5 percentage points can be explained by gender differences in experience at the same age.

Conclusions: Male specialists earn a large and statistically significant premium over their female colleagues. Age, specialty and hours of work do not appear to drive these wage gaps. These findings suggest that employment agreements that specify minimum wages for each level of experience, and progression through these levels, are insufficient to eliminate gender wage gaps between similar men and women with the same experience.

STRENGTHS AND LIMITATIONS OF THE STUDY

- Strengths include being the first study to examine the extent and drivers of gender wage gaps among senior doctors, using actual earnings data in a nationwide study.
- It fills a gap in scant literature on doctor remuneration in relation to collective employment agreements or public health sector employment alone.
- The research uses data from tax records, so it is not subject to self-reporting bias.
- Limitations include the use of cross-sectional data from 2013 so the wage growth of individual specialists over time cannot be analysed.
- Hourly wages are generated by combining data from two sources, a process which introduces some level of error into the data.

INTRODUCTION

Despite their growing presence in medical workforces, women continue to earn significantly less than their male doctor counterparts[1,2]. International research suggests wage gaps between male and female doctors ranging from 13% in the US[3] to 17-23% in Australia[4] and 34% in the UK[5]. The prevalence of gender pay gaps in medicine has been ascribed to the tendency for female doctors to self-select into lower paid medical specialities[6], to work fewer hours than their male counterparts[7] and to take time out of the paid workforce for maternity leave[8]. Other research suggests a pay gap as a consequence of the 'breadwinner effect', where men with children earn more than those without, and the 'carer effect', where women with children earn less than those without[9,10]. In addition, research suggests women in medicine face subtle gender based discrimination[11], are less likely to negotiate on salary offers, all of which may contribute to the persistence of a wage gap[12]. In this research we quantify the gender wage gap for senior doctors in the public health system in New Zealand.

According to the OECD, New Zealand's 2018 gender wage gap in median earnings for all full-time employees was 7.9 percent, considerably below the 13.5 percent on average for OECD countries[13]. Statistics New Zealand (using different methodology) calculated a slightly higher gender wage gap of 9.2 percent in the same year[14]. Neither estimates control for any individual characteristics such as occupation, age, or level of education. Other recent New Zealand studies that estimate the wage gap between similar men and women find it remains sizeable even when controlling for characteristics of the individuals and their jobs[15-17]. Significantly, these studies find a larger wage gap between men and women who are more skilled or higher up the earnings distribution.

New Zealand has a large public health system that provides free or subsidised health and disability services to the New Zealand population, mainly funded through general taxation. The majority of funds managed by the Ministry of Health are allocated to 20 District Health Boards (DHBs). Publicly employed medical staff are employees of and paid by the DHBs. Instead of or in addition to DHB employment, medical specialists may work in the private health system, which operates alongside the public health system and caters to those with private insurance, among others. The majority of general practitioners operate in a private practice capacity.

The medical profession is not typical of high-skill professions in New Zealand. In particular, unionisation among senior doctors (referred to hereafter as medical specialists) working in the public health system is very high, and the pay and conditions negotiated by their union, the Association of Salaried Medical Specialists (ASMS), in their Multi Employer Collective Agreement (MECA) with the 20 DHBs are extended to publicly employed specialists who are not union members, subject to a few conditions. Among other conditions of employment, the MECA specifies minimum salary levels for medical specialists at each level of experience and progression through them. Specialists are assigned to a step when they take up employment with a DHB. This could be the first step if they are newly qualified or could be negotiated between the employee and employer based on past experience and qualification level. In the experience of ASMS, overwhelmingly members advance a step each year until they reach the top step. Those on approved unpaid leave for up to a period of six months, or on parental leave for up to twelve months, are still eligible for these regular pay increases.

In addition to base pay, the MECA specifies that a DHB may pay additional “recruitment and retention benefits” to address actual or potential recruitment problems, and “special contributions benefits” to recognise special skills or responsibilities[18]. Furthermore, it should be noted the MECA sets out minimum pay and conditions for specialists, and individuals or groups may negotiate more favourable additional conditions with their employer. Nonetheless, the salary minima for each step and regular progression through the steps are expected to reduce the scope for a wage gap to arise between equally skilled and experienced men and women who are employed as medical specialists by DHBs.

Little is currently known as to the extent and drivers of gender wage gaps among medical specialists specifically. Furthermore, to the best of the authors knowledge, there are no studies examining doctor remuneration in relation to collective employment agreements or public health sector employment. The aims of this research, which revises existing work [19], are to quantify the gender wage gap for medical specialists in New Zealand public health system employment using actual earnings data, with a focus on controlling for factors such as experience, hours worked, and medical speciality, which are commonly ascribed factors for gender wage gaps.

In this context, we explain our approach to data and analysis before comparing raw characteristics and outcomes of men and women.

METHODS

The main data source used in this research was the Integrated Data Infrastructure (IDI) managed by Statistics New Zealand. The IDI brings together administrative data for the full population of New Zealand and selected survey data from a wide range of sources, and links records for individuals between different data sources. Specifically, this research used the 2013 Census of Population and Dwellings, which provides data on occupation (specialty) and weekly hours worked along with a multitude of other personal and employer characteristics, and the employer monthly schedule (EMS) from Inland Revenue, which records wages paid each month by each employer to each employee in the country.[1] This combination of data sources provided the most recent and complete data available at the time of writing on earnings and hours worked for the full population of DHB-employed medical specialists. In addition, we use the Ministry of Education's tertiary qualifications data to construct the dates individuals received their medical degrees.

Participants

The conceptual population of interest was medical specialists who were employed for wages or a salary in a medical capacity by a DHB at the time of the March 2013 Census. This included individuals for whom this DHB job was the only or main job, and those for whom it was a secondary job. The sample from this population was all individuals who stated their occupation in the Census as a medical specialty (see Appendix A: Included specialties), and who were shown in the EMS to have received wages from a DHB in March 2013, the month of the Census. However, individuals who met these criteria but were observed in the Ministry of Education data to receive a Bachelor of Medicine and Bachelor of Surgery (medical degree) from a New Zealand institution after the year 2013 were excluded. This yielded an overall sample of 4,041 specialists.[2] The full construction of the analysis data set and the sample size at each stage are shown in Figure 1.

Figure 1: Sample construction

Whether or not individuals were International Medical Graduates (IMGs) was determined by analysis of Ministry of Education Qualifications data and Census data on country of birth and years in New Zealand. Individuals were classed as IMGs if they did not receive a medical degree in New Zealand (since 1994, the year data on degrees granted began), were born overseas, and migrated to New Zealand when aged 24 or older. The rationale for this cut-off was that 24 years old is both the modal and median age for receiving a medical degree in New Zealand since 1994.

Patient and Public Involvement

No patients involved

Measures

The primary wage outcome of interest was individual hourly wage earnings in the individual's largest DHB job. This variable was calculated as monthly wages paid by the highest-paying DHB employer divided by weekly hours worked in the DHB job reported in the Census, times (7/31). This calculation was complicated by the necessity of matching Census jobs (the source of hours worked) with EMS jobs (the source of earnings) and the way hours worked is asked in the Census. The Census collects most information about the "main job", defined as the job in which the individual worked the greatest number of hours. Statistics New Zealand processes the information and provides data on industry and sector of employer for main job. Industry and sector are also available for the employer in the EMS data. We applied several criteria sequentially to determine which EMS job (if any) was the main Census job. First, we considered an EMS job to be the main job if it fully matched the main Census job in terms of sector and detailed industry. If two or more EMS jobs met this criterion, the one paying the highest wages was considered the main job. Second, if the sector matched and the industry matched at only the 2-digit level (aggregate industry classification) we defined the EMS job as the main Census job. Multiple matches were dealt with by choosing the EMS job with higher wages. If no EMS jobs matched the sector and aggregate industry of the main Census job, no EMS job was allocated as the main Census job. Inability to identify the main job in the EMS data caused the loss of some observations from our hourly wage data set.

The Census collects two hours worked variables: hours worked in main job and hours worked in all other jobs.[3] If the DHB job is the individual's main job or only job other than their main job, the answers to these questions allowed us to identify how many hours they work for the DHB. We lost from the hourly wage data set observations for individuals with three or more jobs for whom the DHB job was not their main job. We also lost observations where the individual did not complete the Census questions on hours worked, and we dropped the small number of cases for which our calculation yielded wages below $15 an hour.[4] This process resulted in 3,510 observations of hourly wages in main DHB job, which amounted to 86.9% of the desired population.

RESULTS

Table 1 presents descriptive statistics separately by gender for the work outcomes and main controls used in the regression analysis.

Table 1: Means and standard deviations of outcomes of interest and control variables for the sample of male and female specialists with non-missing DHB hourly wage earnings.

	Male		Female	
	Mean	**Standard deviation**	**Mean**	**Standard deviation**
Outcomes				
Monthly wage earnings in DHB job	$15,870	$7,381	$11,920	$6,078
Weekly hours worked in DHB job	44.6	13.9	42.0	14.6
Hourly wage in DHB job	$87.8	$54.8	$71.6	$61.2
Main controls				
Female	0		1	
Age	46.1	11.6	41.2	11.1
Hours worked in DHB job				
30 or fewer hours	0.161		0.240	
31-40 hours	0.229		0.261	
41-50 hours	0.338		0.247	
51-60 hours	0.208		0.189	
Over 60 hours	0.064		0.062	
Observations	2,211		1,299	
Additional controls				
Number of children in family				
0 children	0.422		0.534	
1 child	0.164		0.143	
2 or more children	0.414		0.321	
Highest qualification				
Bachelor's degree	0.341		0.409	
Honours or Master's degree	0.342		0.378	
Doctorate	0.317		0.214	
Foreign born	0.557		0.558	
Overseas trained (IMG)	0.421		0.380	
Any non-European ethnicity	0.259		0.233	
Asian ethnicity	0.185		0.166	
Social marital status				
Currently partnered	0.886		0.727	
Previously partnered	0.029		0.055	
Never partnered	0.084		0.219	
Self-employed	0.429		0.197	
Hours worked in other jobs				
0 hours	0.638		0.817	
1-10 hours	0.142		0.093	
11-25 hours	0.123		0.059	
26-40 hours	0.066		0.021	
Over 40 hours	0.031		0.010	
Observations	2,139		1,263	

Figure 2 displays the change in mean hourly wage in the DHB job and its 95% confidence interval, unadjusted for any characteristics, by age for each gender for medical specialists. For both genders, hourly wages increase gradually to the age of about 30, increase rapidly over the next 10 or 15 years, and then flatten out. This is roughly the age at which specialists who gain their medical degrees at age 24 might be expected to reach the top salary step specified in the MECA that was in force in

March 2013. The gender pay gap in average hourly earnings is small and fairly constant until age 40, but beyond that increases rapidly to give men a wage advantage over women.

Figure 2: Raw hourly wage in main DHB job by age and gender

Gender difference in hourly wage

The gender wage gap in hourly wage earned in specialists' main DHB jobs was calculated by running an ordinary least squares regression at the individual level of the log of hourly earnings on a dummy variable for female and progressively adding in other controls. Column (1) of Table 2 presents the results of the most basic regression, which includes no additional controls. The coefficient of -0.237 on female, which is highly statistically significant, shows that in her DHB job the average female specialist earned an hourly wage that is 21.1 percent lower than the hourly wage of the average male specialist.[5] Column (2) flexibly controls for age using an age spline of order 4, which closely fits the shape of the age-earnings relationship shown in Figure 2, and compares the earnings of men and women of the same age. Here the coefficient on age falls to -0.106, indicating women earn hourly wages 10.1 percent lower than men of the same age. The existence of a gender wage gap between medical specialists of the same age suggests the lower hourly wages of female specialists relative to male specialists is not the result of the female specialists being younger on average.

Table 2: Main estimates of gender wage gap

Dependent variable: Hourly wages in main DHB job (ln)	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.237***	-0.106***	-0.097***	-0.134***	-0.137***	-0.119***
	(0.019)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Hours worked in main DHB job (omitted 41-50 hours)						
30 or fewer hours				0.230***	0.232***	0.197***
				(0.024)	(0.024)	(0.027)
31-40 hours				0.044***	0.045***	0.041**
				(0.017)	(0.017)	(0.017)
51-60 hours				-0.149***	-0.151***	-0.141***
				(0.015)	(0.015)	(0.016)
Over 60 hours				-0.288***	-0.291***	-0.278***
				(0.022)	(0.022)	(0.022)
One-child family						0.015
						(0.021)
Two or more-child family						0.004
						(0.019)
Highest qualification (omitted bachelor's degree)						
Honours and Master's						0.029*
						(0.016)
Doctorate						0.090***
						(0.018)
Foreign born						-0.012
						(0.020)
Overseas trained						0.041**
						(0.021)

	(1)	(2)	(3)	(4)	(5)	(6)
Reports any non-European ethnicity						-0.021
						(0.024)
Reports Asian ethnicity						-0.002
						(0.027)
Social marital status (omitted non-partnered, never married or in civil union)						
Partnered						0.014
						(0.021)
Previously partnered						-0.064
						(0.047)
Self-employed						-0.010
						(0.020)
Hours worked in other jobs (omitted 0 hours)						
1-10 hours						0.091***
						(0.022)
11-25 hours						0.032
						(0.028)
26-40 hours						0.130***
						(0.049)
Over 40 hours						0.233***
						(0.069)
Flexible age controls	No	Yes	Yes	Yes	Yes	Yes
Specialty fixed effects	No	No	Yes	Yes	Yes	Yes
DHB fixed effects	No	No	No	No	Yes	Yes
R-Squared	*0.045*	*0.458*	*0.480*	*0.535*	*0.540*	*0.552*
Observations	*3,510*	*3,510*	*3,510*	*3,510*	*3,510*	*3,402*

Notes: Each column presents results from an OLS regression with dependent variable log hourly wage in main DHB job. Flexible age controls are an age spline of order 4. All observation counts have been randomly rounded to base 3. Robust standard errors are in parentheses. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

Column (3) of the table adds fixed effects for specialty to test the extent to which the gender wage gap is driven by women selecting into lower-paying specialties. Here the coefficient on female falls slightly to -0.097, indicating than women earn an average of 9.2 percent less each hour than men of the same age in the same specialty. Comparison with column (2) shows that women have only a weak tendency to select into lower-paying specialties, and suggests this mechanism plays a very minor role in the overall gender wage gap.

Another potential explanation for the gender wage gap is that female specialists are more likely to work part time, and part-time employees might earn lower hourly wages than full-time employees. Column (4) of Table 2 adds controls for weekly hours worked in the DHB job (30 or fewer hours, 31 to 40 hours, 51 to 60 hours, and over 60 hours, with 41 to 50 hours as the omitted category). It thus compares men and women of the same age, in the same specialty, who work the same number of hours each week in their DHB job. The coefficients on the hours worked variables reveal that, on average over men and women, hourly wage is substantially higher among those who work fewer hours each week in their DHB job. Furthermore, controlling for hours worked substantially increases the coefficient on female from -0.097 to -0.134, indicating women's hourly wages lag those of men of the same age, in the same specialty, who work the same hours in their DHB job by 12.5 percent. This estimate is statistically significant at the 1 percent level and has a 95 percent confidence interval ranging from 9.9 percent to 15.1 percent.

To account for the possibility that some DHBs pay higher wages than others and women are more likely to work for low-wage DHBs, column (5) of Table 2 adds DHB fixed effects and compares similar men and women who work for the same DHB. The gender wage gap here is 12.8 percent, virtually unchanged.

Finally, column (6) of the table adds controls for a range of additional personal characteristics to test the extent to which the gender wage gap can be explained by observable characteristics that might justify differential wages. Controls are included for number of children, highest qualification, being foreign born, having trained overseas, ethnicity, social marital status, and number of hours worked in non-DHB jobs each week. The 108 observations with missing values for any of the included covariates are dropped here and in subsequent tables.

In this specification, the gender wage gap falls to 11.2 percent and remains highly significant. To verify our treatment of missing values does not drive this result, we alternatively impute all missing covariates to minimise the estimated gender wage gap and impute all missing covariates to maximise the gap. With these extreme imputations, our estimate of the wage gap varies only from 11.0 percent to 11.4 percent. We thus conclude treatment of the missing values has little bearing on the estimated gender wage gap. The regression also shows working in additional non-DHB jobs was strongly associated with higher hourly earnings in the DHB job. For instance, those who work 1 to 10 hours each week in other jobs earn 9.5 percent higher wages than those who work only for the DHB, and those who work 26 to 40 hours in other jobs earn 13.9 percent higher wages. Having a doctorate is also associated with significantly higher earnings.

Appendix 1 replicates columns (2), (5), and (6) of Table 2 separately for medical specialties, surgical specialties, general practice, and other specialties. It shows the gender wage gap is present and of comparable size for each of these specialties.

The above analysis controls for age as a proxy for experience. However, women may have less experience than men at the same age if they entered the profession later or had more gaps in their employment, such as for raising children. For specialists who received their medical degrees in New Zealand in 1994 or later, we explored this possibility in Table 3. The baseline wage gap for this sample between men and women of the same age, controlling for other major covariates, was 7.1 percent (column 1). Instead comparing those who received medical degrees in the same year reduced the wage gap to 6.3 percent (column 2). Additionally accounting for estimated time away from work for parental responsibilities reduces the gender wage gap to 5.6 percent (column 3).[6] Thus for specialists who were qualified in New Zealand in 1994 or later, accounting for differences in age entering the profession and average breaks for parental responsibilities explains only 21.0 percent of the gender wage gap.

Table 3: Gender wage gap varying controls for experience

Dependent variable: Hourly wages in main DHB job (ln)				
	Trained in NZ since 1994			
	(1)	(2)	(3)	(4)
Female	-0.074***	-0.065**	-0.058**	-0.047**
	(0.026)	(0.025)	(0.025)	(0.023)
Hours worked in main DHB job (omitted 41-50 hours)				
30 or fewer hours	0.376***	0.337***	0.345***	0.323***
	(0.086)	(0.092)	(0.091)	(0.084)
31-40 hours	0.158***	0.137***	0.135***	0.140***
	(0.044)	(0.040)	(0.039)	(0.039)

51-60 hours	-0.205***	-0.167***	-0.166***	-0.160***
	(0.025)	(0.023)	(0.023)	(0.023)
Over 60 hours	-0.324***	-0.271***	-0.270***	-0.267***
	(0.027)	(0.025)	(0.025)	(0.025)
Highest qualification (omitted bachelor's degree/level 7)				
Honours and Master's	0.016	0.011	0.013	0.005
	(0.025)	(0.024)	(0.024)	(0.025)
Doctorate	0.141***	0.077*	0.066	0.076*
	(0.046)	(0.044)	(0.044)	(0.044)
Age spline	Yes	No	No	No
Years since qual spline	No	Yes	No	No
Years since qual with child adjustment spline	No	No	Yes	Yes
Hours worked in other jobs controls	No	No	No	Yes
Specialty fixed effects	Yes	Yes	Yes	Yes
R-Squared	*0.623*	*0.656*	*0.660*	*0.670*
Observations	*759*	*759*	*759*	*759*

Notes: Each column presents results from an OLS regression with dependent variable log hourly wage in main DHB job. The sample is specialists who gained their medical degree in New Zealand in 1994 or more recently. All observation counts have been randomly rounded to base 3. Robust standard errors are in parentheses. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

Another way that experience might affect earnings is through longer working weeks, which enable a specialist to accumulate experience more quickly. In column (4) of Table 3 we add controls for number of weekly hours worked in other jobs, reducing the gender wage gap to 4.6 percent (significant at the 5 percent level). Overall, 35.6 percent of the gender wage gap for this subpopulation, or 2.5 percentage points of a total of 7.1, can be explained by these past and contemporaneous experience controls. Assuming differential experience at the same age had the same explanatory power in the full sample, this would mean it explained 4.5 percentage points of the overall 12.5 percent gender wage gap.

Heterogeneity in the gender wage gap

In Table 4 we present the results of regressions that test how the within-specialty gender wage gap between similar men and women differs with personal characteristics. Column (1) shows the gap increases with age, from 4.3 percent for ages 30 to 39 up to 14.6 percent for ages 40 and over. Column (2) shows the gap is larger among specialists who work fewer hours each week in their DHB job, at 20.5 percent among those who work up to 30 hours per week, compared with only 4.2 percent for those who work over 60 hours. Column (3) suggests the gap might be smaller among specialists who work more hours in other jobs, but statistical power is too low to be confident of this relationship. Column (4) shows the gap rises with number of children in the household, from 8.1 percent between men and women with no children in their families to 15.4 percent between those in families with two or more children. Column (5) shows there is no significant difference in the gender wage gap for specialists who trained overseas or recent migrants (who arrived in New Zealand no more than a year before the 2013 Census). Column (6) shows the gap is lower among more qualified specialists, falling from 15.6 percent for those with bachelor's degrees only to 6.3 percent for those with doctorates.

Table 4: Heterogeneity of gender wage gap

Dependent variable: Hourly wages in main DHB job (ln)	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.106***	-0.072***	-0.123***	-0.084***	-0.117***	-0.170***
	(0.031)	(0.022)	(0.016)	(0.020)	(0.019)	(0.025)
Aged under 30 * Female	0.062*					
	(0.038)					
Aged 40+ * Female	-0.052					
	(0.035)					
Worked 30 or fewer hours in main DHB job * Female		-0.158***				
		(0.048)				
Worked 31-40 hours * Female		-0.051				
		(0.035)				
Worked 51-60 hours * Female		-0.042				
		(0.033)				
Worked over 60 hours * Female		0.029				
		(0.043)				
Works 1-25 hours in other jobs * Female			-0.006			
			(0.033)			
Works 26 or more hours in other jobs * Female			0.107			
			(0.111)			
One-child family * Female				-0.045		
				(0.040)		
Two or more-child family * Female				-0.083***		
				(0.032)		
Overseas trained * Female					-0.001	
					(0.028)	
Recent migrant * Female					-0.002	
					(0.059)	
Honours or Master's * Female						0.068**
						(0.032)
Doctorate degrees * Female						0.105***
						(0.034)
One-child family				0.035		
				(0.025)		
Two or more-child family				0.040**		
				(0.019)		
Overseas trained					0.022	
					(0.016)	
Recent migrant (arrived Mar 2012 or later)					0.077**	
					(0.038)	
Flexible age controls	No	Yes	Yes	Yes	Yes	Yes
Age category fixed effects	Yes	No	No	No	No	No
Specialty fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	*0.532*	*0.548*	*0.546*	*0.547*	*0.547*	*0.547*
Observations	*3,402*	*3,402*	*3,402*	*3,402*	*3,402*	*3,402*

Notes: Each column presents results from an OLS regression with dependent variable log hourly wage in main DHB job. Flexible age controls are an age spline of order 4. Additional controls are fixed effects for number of hours worked in DHB job, fixed effects for number of hours worked in other jobs, and fixed effects for highest qualification. All observation counts have been randomly rounded to base 3. Robust standard errors are in parentheses. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

DISCUSSION

This study reports on the first analysis into the gender gap in hourly wages of a senior medical workforce across an entire country, based on actual earnings data. It extends existing research by examining associations between hourly wages and age, experience, medical speciality, and other demographic factors such as numbers of children and ethnicity. It proposes an approach to measuring and estimating gender pay gaps and further, contributes to the wider literature by considering the role of multi-employer collective agreements as a factor that should limit the opportunity for gender pay gaps to arise.

Despite specialist salaries being specified by the MECA negotiated by the Association of Salaried Medical Specialists, we find male specialists earn a large and statistically significant premium over their female colleagues. When we compare male and female specialists of the same age, in the same specialty, who work the same number of hours each week, we find female specialists earn on average 12.5 percent lower hourly wages than their male counterparts in their DHB employment, with a 95 percent confidence interval of 9.9 to 15.1 percent. Adding controls for a wide range of personal and work characteristics decreases the estimated gap only slightly to 11.2 percent.

The wage gap increases with age from 4.3 percent for under-30s to 14.6 percent for those aged 40 and over. For specialists without children, there is a smaller but still statistically significant gender wage gap of 8.1 percent. This gender wage gap rises to 12.1 percent for those with one child and to 15.4 percent for those with two or more children. Given the average female medical specialist reduces her lifetime months worked by on average five months for each child she bears, and the ASMS MECA specifies that specialists on parental leave for up to 12 months will receive the same regular pay increases as they would receive were they not on leave, these wage gaps for parents cannot be explained by time out of the paid workforce for parental leave alone. As well as being larger among parents, we find the wage gap increases with age and is higher for specialists who work fewer hours each week in their DHB job, reaching 20.5 percent for those who work 30 or fewer hours, and is lower for specialists with higher degrees, falling to 6.3 percent among those with doctorates.

These wage gaps flexibly account for age, so are not driven by female specialists being younger on average than male specialists. They compare men and women in the same specialty, so are not driven by female specialists choosing to work in lower-paying specialties. They also control for weekly hours worked in the DHB job, weekly hours worked in other jobs, and highest qualification. They are thus not driven by female specialists being more likely to work part-time, either for the DHB or in total, and part-time employees earning lower hourly wages than full-time employees. In fact, although female specialists are more likely to work part-time in their DHB job, part-time specialists, especially men, tend to earn an hourly wage premium over full-time specialists.

Our results suggest that, at most, 36 percent of the 12.5 percent wage gap, or 4.5 percentage points, can be explained by differences in experience. Furthermore, the data show that hourly earnings are relatively stable for men and women beyond approximately 45 years of age, which suggests that beyond a certain level of seniority hourly wages are determined almost entirely by factors other than experience.

In the context of the MECA that governs the earnings of DHB-employed medical specialists, the gender wage gap we estimate could arise from one of two places. First, men with the same experience could be placed in higher steps on the salary scale on recruitment. This has greater potential to occur for specialists who work in New Zealand after gaining experience overseas than for New Zealand-trained specialists who have worked only in New Zealand, who are more likely to enter the pay scale on the lowest rung and deterministically progress up a step each year. Second, men could receive larger payments over and above the MECA minimum, which could include recruitment and retention benefits or special contributions benefits.

Although we do not find direct evidence that male specialists who migrate to New Zealand are initially placed on a higher pay step than similar female specialists, we do find a substantial gender pay gap among new immigrants, and are unable to rule out that such unequal treatment occurs. Our data do not allow us to distinguish base salary as specified by the MECA from the various additional payments, but our results are consistent with male specialists disproportionately receiving additional payments beyond the MECA minimum for their salary step. This demonstrates that an employment agreement that specifies minimum wages for each level of experience and progression through these levels is insufficient to eliminate the gender wage gap between similar men and women with the same experience.

The broader literature on gender pay equality proposes employer discrimination and more successful salary negotiation on the part of men as two potential explanations for a gender wage gap such as that observed here. It is possible that both play a role in the gender wage gap for medical specialists.

Although the gender wage gap we estimate is sizeable, it is smaller than the average gap for high-skilled occupations in New Zealand [17]. Two major factors may contribute to limiting the gender wage gap in our setting. First, the near-universally applicable MECA likely reduces the scope for negotiation that may favour men. Second, the labour market for medical specialists in New Zealand is tight, with DHBs perpetually struggling to fill positions; ASMS research suggests in 2020 the shortage of specialists was as high as 24 percent [20]. Theoretically this means it is more costly for employers to discriminate against women [21-23], and previous research [15] has shown in such situations gender wage gaps do tend to be lower, particular when product markets are competitive.

Our research approach has several limitations, a key one being that we are unable to identify what drives the gender wage gap. Another possible limitation is that the sources of the data on hours worked and monthly earnings are different. Some error is introduced through mismatched individuals and individuals whose pay in March 2013 was the result of a different numbers of hours of work to their usual hours, and some specialists with three or more jobs are lost because the hours worked in their DHB job can't be identified. The cross-sectional data also means that the wage growth of individual specialists over time cannot be analysed.

Nevertheless, this research provides clear evidence that there are likely to be significant issues with gender pay inequity for medical specialists working in New Zealand's public health system. The results of this research indicate a need for a comprehensive series of gender pay audits within the nation's DHBs and to ensure that existing and future remuneration arrangements are fair and unbiased.

a. Contributorship statement: The research was designed and conducted by Dr Sin and Ms Bruce-Brand, with contributions received from Dr Chambers. All authors edited and revised the final submission and signed off on the final version.

b. Competing interests: There are no competing interests

c. Funding: This research was funded by the Association of Salaried Medical Specialists

d. Data sharing statement: No additional data available

e. Acknowledgements: Access to the anonymized data used in this study was provided by Statistics New Zealand in accordance with security and confidentiality provisions of the Statistics Act 1975, and secrecy provisions of the Tax Administration Act 1994. The findings are not Official Statistics. The results in this paper are the work of the authors, not Statistics NZ, Motu Economic and Public Policy Research, or the Association of Salaried Medical Specialists, and have been confidentialised to protect individuals, households, businesses, and other organizations from identification. See the Motu Working Paper version of this research (http://motu-www.motu.org.nz/wpapers/19_21.pdf) for the full disclaimer.

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[1] The most recent 2018 census data were deemed unsuitable due to a high non-response rate and resulting poor data quality caused by the shift to an online survey.

[2] These numbers, and all other population counts in this paper, have been randomly rounded to base three for confidentiality reasons, as required by Statistics New Zealand.

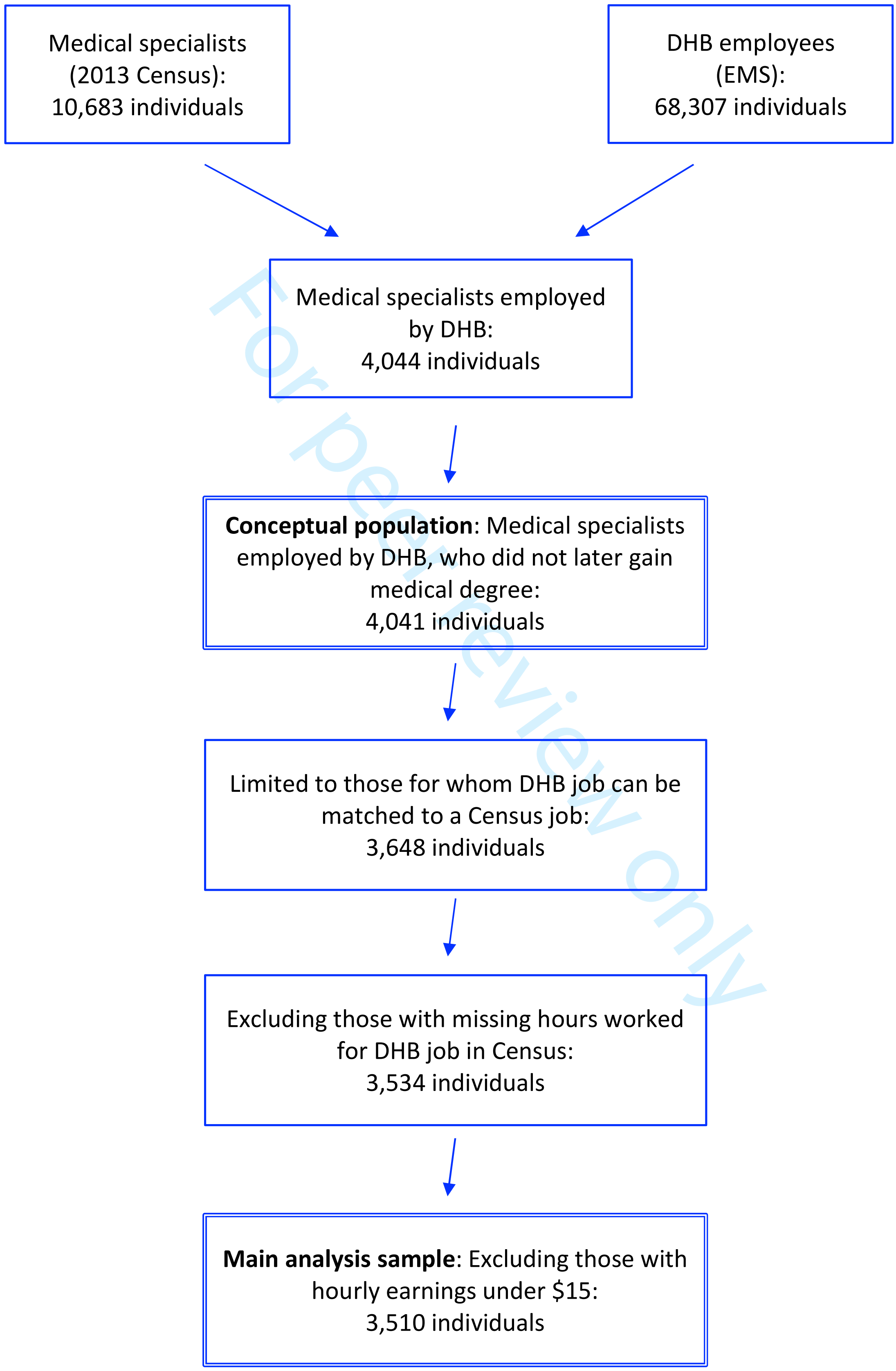
[3] In both cases, the wording of the question is "How many hours, to the nearest hour, do you usually work each week?" We can only speculate on how individual specialists interpret this question, but it seems plausible that many will include on call hours in the number they report.

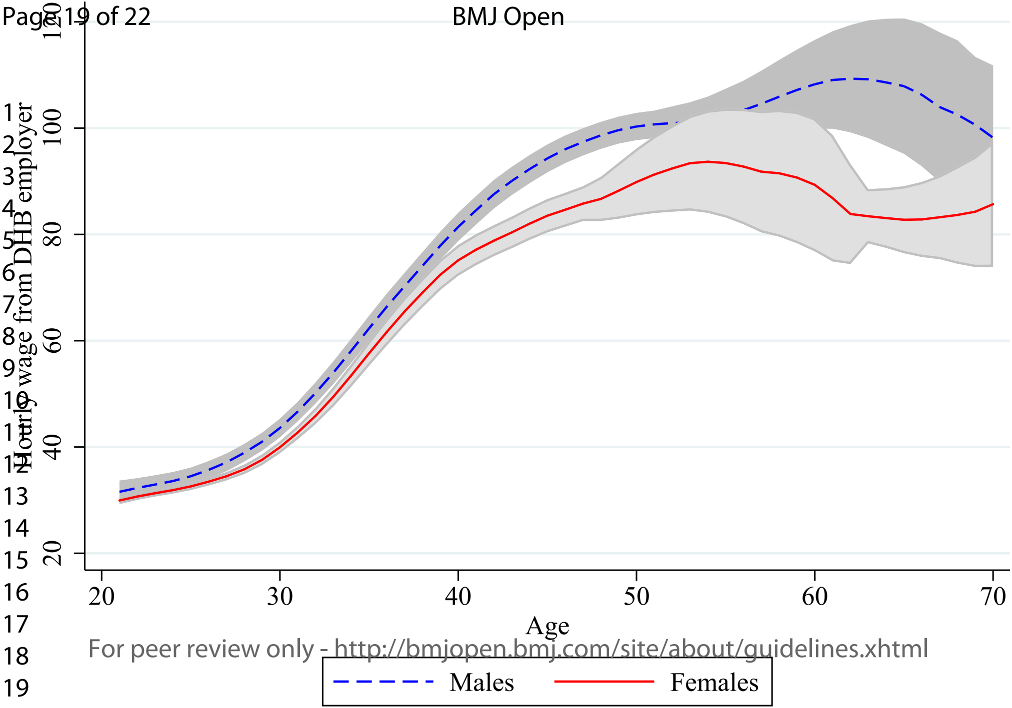
[4] Our preferred estimate of the overall gender wage gap for specialists falls from 12.5 percent to 11.6 percent when we instead use a cut-off of $20. However, using this larger cutoff disproportionately drops (low-paid) women from the sample, so is likely to underestimate the gender wage gap.

[5] $1 - \exp(-0.237) = 21.1$ percent.

[6] Separate regressions (not shown) estimated that having a child reduces the months in which a female doctor works by 5 months on average, whereas male doctors do not decrease their months worked when they have children. An adjusted years of experience variable was constructed that was equal to years since gaining medical degree for men, and years since gaining medical degree minus five months for every live child given birth to for women. Column 3 controls flexibly for this adjusted experience measure.

Figure 1: Sample construction




Hourly wage from DHB employer
20
40
60
80
100
120
20
30
40
50
60
70
Age
Males
Females

Appendix A: Included specialties

This table lists the level 5 ANZSCO occupation codes and occupation descriptions of the medical specialties included in the analysis.

Code	Description
252311	Dental Specialist
252312	Dentist
253111	General Practitioner
253211	Anaesthetist
253311	Specialist Physician (General Medicine)
253312	Cardiologist
253313	Clinical Haematologist
253314	Medical Oncologist
253315	Endocrinologist
253316	Gastroenterologist
253317	Intensive Care Specialist
253318	Neurologist
253321	Paediatrician
253322	Renal Medicine Specialist
253323	Rheumatologist
253324	Thoracic Medicine Specialist
253399	Specialist Physicians not elsewhere classified
253411	Psychiatrist
253511	Surgeon (General)
253512	Cardiothoracic Surgeon
253513	Neurosurgeon
253514	Orthopaedic Surgeon
253515	Otorhinolaryngologist
253516	Paediatric Surgeon
253517	Plastic and Reconstructive Surgeon
253518	Urologist
253521	Vascular Surgeon
253911	Dermatologist
253912	Emergency Medicine Specialist
253913	Obstetrician and Gynaecologist
253914	Ophthalmologist
253915	Pathologist
253917	Diagnostic and Interventional Radiologist
253918	Radiation Oncologist
253999	Medical Practitioners not elsewhere classified

Appendix Table 1: Estimates of gender wage gap by specialty

Dependent variable: Hourly wages in main DHB job (ln)			
	(1)	(2)	(3)
Panel A: Medical specialties			
Female	-0.124***	-0.142***	-0.112***
	(0.038)	(0.036)	(0.040)
Observations	*633*	*633*	*615*
Panel B: Surgical specialties			
Female	-0.134**	-0.087	-0.092
	(0.058)	(0.056)	(0.057)
Observations	*546*	*546*	*537*
Panel C: General practice			
Female	-0.088***	-0.126***	-0.117***
	(0.023)	(0.023)	(0.024)
Observations	*1,113*	*1,113*	*1,071*
Panel D: Other specialties			
Female	-0.100***	-0.127***	-0.106***
	(0.025)	(0.025)	(0.026)
Observations	*1,215*	*1,215*	*1,182*
Flexible age controls	Yes	Yes	Yes
Hours worked in main DHB job fixed effects	No	Yes	Yes
Detailed specialty fixed effects	No	Yes	Yes
DHB fixed effects	No	Yes	Yes
Additional controls	No	No	Yes

Notes: Each coefficient is from a separate OLS regression with dependent variable log hourly wage in main DHB job run for a subset of specialties only. Panel headers give the included specialties and the lowest panel gives the additional controls included. Flexible age controls are an age spline of order 4. Additional controls are as in column (6) of Table 2. All observation counts have been randomly rounded to base 3. Robust standard errors are in parentheses. Asterisks denote: * p<0.10, ** p<0.05, *** p<0.01.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6*
Bias	9	Describe any efforts to address potential sources of bias	5-6
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-11
		(*b*) Describe any methods used to examine subgroups and interactions	10-12
		(*c*) Explain how missing data were addressed	10
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	10-11
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5-7
		(b) Indicate number of participants with missing data for each variable of interest	5-7
Outcome data	15*	Report numbers of outcome events or summary measures	7

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-10
		(*b*) Report category boundaries when continuous variables were categorized	8-9
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	10-12
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.